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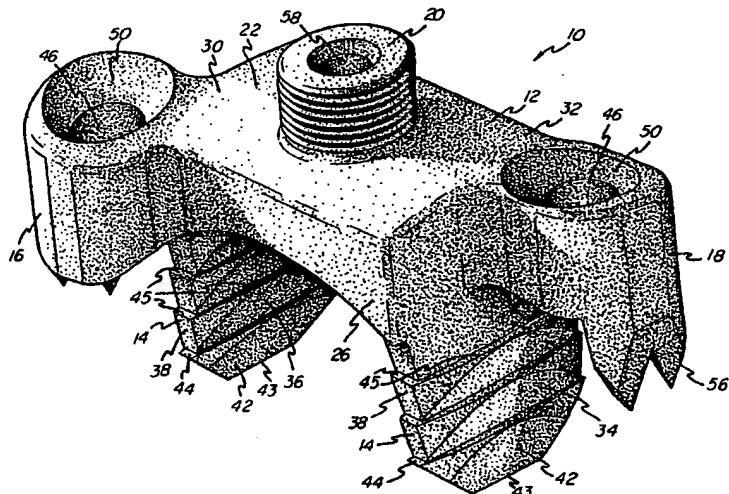
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(71) Applicants and

(72) Inventors: WALL, M., D., Eric, J. [US/US]; 3280 Tiffany Ridge Lane, Cincinnati, OH 45241 (US). BYLSKI-AUSTROW, Ph., D., Donita, I. [US/US]; 4932 Twinbrook Court, Cincinnati, OH 45242 (US).

(54) Title: SPINAL CORRECTION SYSTEM



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SPINAL CORRECTION SYSTEM

Background of the Invention

This invention relates to devices for use in the correction, arresting or
5 slowing of abnormal curvature of the spine, including scoliosis, hyperlordosis and
hypokyphosis.

Juvenile and adolescent scoliosis is a disorder of the growing spine in
which a predominantly lateral curvature develops. Curves over 40° can require
surgical correction due to the high risk of future progression during adulthood. One
10 typical procedure, often called "posterior approach scoliosis surgery," is one of the
most invasive human surgeries in orthopedics. During a typical three to eight hour
procedure, a surgeon strips the strong posterior muscles off of the spine for bone
exposure, then attaches two metal rods to the spine with hooks, wires, or screws. An
alternative scoliosis approach is through the anterior chest via thoracotomy or
15 thoracoscopy. After multi-level discectomy and fusion, large screws are placed
across the vertebral bodies, and then the screws and vertebrae are compressed
together by means of a vertical rod.

Staples are often used in orthopaedics to fix two bones or pieces of
bone together, such as would be required for osteotomy (bone cutting), or fracture
20 stabilization. Staples typically used for these purposes are disclosed in U.S. Patents
4,434,796 by Karapetian; 3,862,621 to Austin; 4,841,960 to Garner; 4,848,328 to
Laboureau et al.; 5,449,359 to Groiso; 5,053,038 to Sheehan; and 4,913,144 to Del
Medico.

Orthopaedic staples are also used in the fixation of soft tissue to bone,
25 such as tendon or shoulder tissue. Staples typically used for these purposes are
described in U.S. Patents 5,352,229 to Goble et al.; 4,462,395 to Johnson; 4,570,623
to Ellison et al.; 4,454,875 to Pratt et al.; D320,081 to Johnson; and D340,284 to
Johnson.

In addition, several screws with a linkage plate or rod have been
30 developed for anterior spine fixation and are described in U.S. Patents 5,324,290 to
Zdeblick et al.; and 4,041,939 to Hall.

Additional U.S. Patents disclose spine staples, for example U.S.

Patents 4,047,523 to Hall; 4,047,524 to Hall; 5,395,372 to Holt et al.; D378,409 to Michelson; and D364,462 to Michelson.

The inventors have developed a novel procedure for correcting scoliosis in children that takes advantage of future spine growth to correct the 5 scoliosis. This procedure relies upon slowing spine epiphyseal growth on the convex side of the scoliosis curve with a novel hemiepiphyseal spinal correction system.

The novel procedure using the novel spinal correction system requires only one- fourth of the time necessary for conventional implantation techniques and may be performed using minimally invasive endoscopic procedures. In addition, the 10 novel spinal correction system has an extremely low profile which reduces the risk of neurological complications.

This new procedure uses a novel system of staples and screws to provide anterior non-fusion (no bone graft) correction of scoliosis in children with significant growth remaining. The procedure can be performed entirely 15 endoscopically in as little as one hour of surgical time. This procedure using the novel spinal staple avoids the complex rod-screw linkage of current anterior scoliosis corrective systems. It also holds the potential for making correction an outpatient procedure and minimizes blood loss during surgery.

Existing spinal implants do not take advantage of the 20 hemiepiphysiodesis principle of altering spine growth and allowing for gradual correction through asymmetric growth. Prior art bone staples used to fix two bones or pieces of bone together, for example, are not designed to perform hemiepiphysiodesis, and are not designed or able to resist the forces of spinal motion and growth without significant splay. Orthopaedic staples used to fix soft tissue to 25 bone are not designed to span two bones or two pieces of bone. Thus, such staples are inapplicable to the novel procedure for the correction of scoliosis in children.

The other staples mentioned above were not designed for spine hemiepiphysiodesis and are instead intended for other purposes. For example, U.S. Patent 4,041,939 to Hall discloses small staples to stabilize a screw-bone interface 30 and to prevent migration or plowing of a screw through a bone. Likewise, U.S. Patent 4,047,524 to Hall discloses a spinal staple meant to stabilize the screw-bone interface of a screw and rod system. U.S. Patent 4,047,523 to Hall discloses a

surgical sacral anchor implant that is half of a staple blade affixed to a cable for the fixation of the lower end of the spine. U.S. Patent 5,395,372 to Holt et al., is a spinal staple that holds a strut bone graft in place and is designed for use after vertebrectomy.

- 5 Thus, there exists a need for a spinal correction system that is small and designed to span vertebral endplate growth centers on either side of a disk.

Summary of the Invention

The above noted concerns and needs are addressed by the novel spinal
10 correction system including a spinal staple in accordance with the invention. The spinal staple includes a bridge member having a length sufficient to span the vertebral endplate growth centers on either side of a vertebral disk. A pair of spaced apart wedged-shaped legs extend downwardly from the end of the bridge member and are of such a length as to penetrate no more than about half way into the depth of
15 a vertebra. Fastener retaining portions extend horizontally outward from the opposite ends of the bridge member and define passageways therethrough adapted to receive fasteners such as screws and the like. The fastener retaining portions are proportioned so that when two or more of the spinal staples of the invention are arranged in end-to-end adjoining relationship, the fastener retaining portions
20 extending from the abutting ends lie side by side.

The legs of the staple are equipped with barbs to resist backing out or loosening of the staple after it has been affixed to a vertebra. In addition, the fastener retaining portions have barbs or projections extending from a lower surface thereof to promote fixation of the staple in a vertebra. Optionally, the staple may be provided
25 with a threaded cannulated post extending upward from the upper surface of the bridge member to allow attachment of a threaded removable, cannulated impaction device. Further, additional surgical hardware may be conveniently affixed to the staple by means of the threaded post.

The invention will be further described and illustrated in conjunction
30 with the following detailed description and appended drawings.

Brief Description of the Drawings

Fig. 1 is a perspective view of a spinal staple in accordance with the invention;

Fig. 2 is a front elevation view of the spinal staple of Fig. 1;

5 Fig. 3 is a perspective view of the spinal staple showing the underside of the staple;

Fig. 4 is a top plan view of the spinal staple;

Fig. 5 is an end elevation view of the spinal staple;

10 Fig. 6 is a perspective view of two of the spinal staples in accordance with the invention aligned in end-to-end adjoining relationship;

Fig. 7 is a top plan view of three of the spinal staples of the invention installed in a spine in end-to-end relationship;

15 Fig. 8 is an elevation view in partial section of a spinal correction system in accordance with the invention affixed to two vertebrae so as to span two endplate growth centers and an intervening disk;

Fig. 9 is a top plan view of an alternative embodiment of the spinal staple in accordance with the invention; and

Fig. 10 is a perspective view of two of the alternative embodiment spinal staples aligned in end-to-end adjoining relationship.

20

Detailed Description of the Preferred Embodiment

Referring to Figs. 1-6, a spinal staple 10 constructed in accordance with the invention is shown. The staple 10 includes a bridge member 12, a pair of spaced apart legs 14, a left fastener retaining portion 16, a right fastener retaining portion 18, and a threaded post 20. Although reference will be made throughout this description to terms implying direction such as left, right, front, back, upper and lower, these terms are used only for convenience in describing the staple 10 and should not be read as limiting the staple 10 to any particular orientation.

The bridge member 12 includes an upper surface 22, an opposed lower surface 24, a front side 26, an opposed back side 28, a left end 30 and an opposed right end 32. The upper surface 22 is substantially planar in a direction extending from the left end 30 to the right end 32, and is convex in a direction from

- the front side 26 to the back side 28, as may best be seen in Fig. 5 when the staple is viewed from one of the ends. The lower surface 24 is concave in a direction from the left end 30 to the right end 32 and from the front side 26 to the back side 28, as may best be seen in Figs. 2 and 3. The bridge member 12 thus defines a pair of
- 5 cooperating arches, a first arch extending between the left and right ends 30 and 32 and a second arch extending between the front and back sides 26 and 28..
- The legs 14 extend downwardly from the lower surface 24 at the left and right ends 30, 32, and are substantially wedge-shaped. Each leg 14 has an outer surface 34, an opposed inner surface 36 such that the inner surfaces 36 are facing
- 10 each other, a front surface 38, and an opposed back surface 40. Each of the legs 14 has a width as measured from the front surface 38 to the back surface 40, which is substantially equal to the width of the bridge member 12 as measured from the front side 26 to the back side 28. The legs 14 narrow slightly from the front surface 38 to the back surface 40 toward their respective tips 42 which are sharply tapered to
- 15 define a blade edge 43. Barbs 44 project outwardly from each of the outer, inner, front, and back surfaces 34, 36, 38 and 40, respectively.

Each barb 44 includes a retaining surface 45 facing generally away from the respective tip 42 and facing generally toward the bridge member 12. As such, the barbs 44 are adapted to inhibit withdrawal movement of the staple 10 once

20 the staple 10 has been positioned in its fixation environment, such as a vertebra. The inner surface 36 of the legs 14 are preferably splayed, or angled, away from each other at an angle of about 10° as measured from a vertical plane 47 extending perpendicularly through the cross-section of the bridge member 12. The outer surfaces 34 of the legs 14 extend downwardly substantially perpendicular to the

25 bridge number 12 and substantially parallel to the vertical plane 45.

The left fastener retaining portion 16 extends outwardly from the bridge member left end 30. The right fastener retaining portion 18 extends outwardly from the bridge member right end 32. Each of the fastener retaining portions 16, 18 define a passageway 46 therethrough adapted to receive therein a fastener, such as a

30 screw . The fastener retaining portions 16, 18 and the passageways 46 are adapted to guide a fastener in a direction substantially parallel to the legs 14. Also, the fastener retaining portions 16, 18 each include front and back sides 49 and 51 and are

proportioned so that when two of the staples 10 are in end-to-end abutting relation, as shown in Fig. 6, then the fastener retaining portions 16, 18 extending from abutting ends are in side-to-side adjoining relation to each other. In other words, the left fastener retaining portion 16 on one staple 10 lies alongside the right fastener 5 retaining portion 18 of the other staple 10. Moreover, the back side 51 of the left fastener retaining portion 16 of a first staple 10 is positioned in proximity to and facing the front side 49 of the right fastener retaining portion 18 of an adjacent second staple 10.

As may be seen in Fig. 4, a longitudinal axis 48 extends through the 10 center of the staple 10 from the left end 30 to the right end 32. In a preferred embodiment, the left and right fastener retaining portions 16, 18 lie on opposite sides of the longitudinal axis 48.

In an alternative embodiment, shown in Figs. 9 and 10, the fastener retaining portions 16 and 18 may extend from opposite ends of the bridge member 12 15 such that both portions 16 and 18 lie to the same side of the longitudinal axis 48. In such an alternative embodiment, the staples 10 may be arranged in end-to-end abutting relation by rotating adjoining staples end-for-end 180°. Then, the left (right) fastener retaining portion 16 (18) of one staple 10 will lie alongside the left (right) fastener retaining portion 16 (18) of the adjoining staple 10. Moreover, the 20 back side 51 of one fastener retaining portion 16, 18 will be in proximity to and facing the back side 51 of a second fastener retaining portion 16, 18.

Each of the fastener retaining portions 16 and 18 includes a counter sunk portion 50 adapted to receive the head of a fastener therein. In addition, each fastener retaining portion 16, 18 also includes a lower surface 52 having pointed 25 projections 54 extending downwardly therefrom for engaging underlying bone. Pointed barbs 56 also extend downwardly from the fastener retaining portions 16, 18.

The threaded post 20 extends upwardly from the upper surface 22 of the bridge member 12. The threaded post 20 cooperates with the bridge member 12 to define a passageway 58 coaxial with the post 20 and extending through the post 20 30 to the lower surface 24 of the bridge member 12. The threaded post 20 permits the attachment of additional hardware or instruments to the staple 10, while the passageway 58 allows for the passage of a guide wire, if desired. Further, the

cannulated threaded post 20 facilitates attachment of a threaded removable, cannulated impaction device.

The staple 10 may be made of titanium, surgical stainless steel, or any other material sufficiently strong to resist the growth of a spinal column, and
5 sufficiently non-reactive in the environment of a living animal.

Referring to Figs. 7 and 8, the staples 10 are inserted into the vertebrae 60 of an animal having an immature or growing spine exhibiting scoliosis or other spinal deformity. The staples 10 are of a size such that the legs 14 are spaced far enough apart that the staples 10 will bridge longitudinally or lengthwise

- 10 aligned, adjoining vertebrae 60 having confronting endplate growth centers 62 with predetermined thicknesses, and an intervening disk 64 therebetween. The staples 10 are driven into an intermediate portion 66, between endplate growth centers 62, of adjoining vertebrae 60 on the convex side of the curved spine. The legs 14 are of such a length that they extend into the vertebrae 60 no more than one-half the
15 transverse diameter of each vertebra. When positioned properly, the legs 14 are fully embedded in the vertebrae 60, and the projections 54 and barbs 56 of the fastener retaining portions 16, 18 engage the vertebral surfaces. Once a staple 10 is in place, fasteners 68 such as screws, barbed stakes, or the like are inserted through the passageways 46 in the fastener retaining portions 16, 18 and into the vertebrae 60.

20 The spinal correction system, when installed on a growing spine having abnormal curvature defining a convex side and an opposed concave side, with the spine including a plurality of lengthwise adjoining vertebrae 60 each having a pair of endplate growth centers 62, or longitudinal growth plates, with an intermediate portion 66 in between, the vertebrae 60 also having a particular

- 25 diameter or thickness in a direction measured from the convex side to the concave side, is broadly seen to include a first bone engaging means or leg 14 that penetrates the convex side of an intermediate portion 66 of a first vertebra to a depth of less than one-half the diameter of the first vertebra, a second bone engaging means or leg 14 penetrating the convex side of an intermediate portion 66 of a second vertebra to a
30 depth of less than one-half the diameter of the second vertebra, and a bridge member 12 rigidly connecting the first and second bone engaging means 14. As may be appreciated, the concave lower surface 24 of each staple 10 substantially matches or

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follows the contour of the vertebral body defined by the vertebrae 60.

The spinal correction system 10 thus corrects the abnormal curvature of the growing spine by inhibiting or retarding the growth of the endplate growth centers 62 captured between the first and second bone engaging means 14 on the

- 5 convex side of the spine, while permitting the unrestrained growth of the endplate growth centers 62 on the concave side of the spine. As the spine continues to grow, the concave side of the spine will grow faster relative to the convex side, thereby resulting in flattening of the curvature and straightening of the spine.

While the legs 14 are primarily responsible for restraining the growth
10 of the endplate growth centers 62 captured therebetween, it will be seen that the fastener retaining portions 16, 18 and fasteners 68 also contribute to restraining the growth of the endplate growth centers 62 captured therebetween. The legs 14 may even be omitted provided that the fastener retaining portions 16, 18 and cooperating fasteners 68 are adapted to sufficiently resist the spreading forces due to lengthwise
15 growth of the endplate growth centers 62.

While the spinal correction system is intended primarily for correcting abnormal lateral curvature of an immature or growing spine, it may also be used for spinal correction in humans having mature or non-growing spines. In such cases, discectomy and fusion would be required before fixing the system to the vertebrae.

20 While the forms of apparatus herein described constitute preferred embodiments of this invention, it is to be understood that the invention is not limited to these precise forms of apparatus, and that changes may be made therein without departing from the scope of the invention which is defined in the appended claims.

What is claimed is:

--CLAIMS--

1. A spinal correction system comprising:
 - a bridge member having an upper surface, an opposed lower surface, a front side, an opposed back side, a left end, and an opposed right end;
 - a left fastener retaining portion extending from said bridge member left end, said left fastener retaining portion having front and back sides;
 - a right fastener retaining portion extending from said bridge member right end, said right fastener retaining portion having front and back sides; and
 - wherein each of said fastener retaining portions are proportioned so that when first and second ones of said spinal correction systems are positioned with one of said ends of said first spinal correction system adjacent one of said ends of said second spinal correction system thereby defining a pair of adjacent ends, each of said fastener retaining portions extending from said adjacent ends is positioned with one of said sides facing one of said sides of the other said fastener retaining portion extending from the other said adjoining end.
2. A spinal correction system according to claim 1 wherein:
 - said left fastener retaining portion extends from said bridge member left end adjacent one of said bridge member front side and said bridge member back side; and
 - said right fastener retaining portion extends from said bridge member right end adjacent the opposite said bridge member side as said left fastener retaining portion.
3. A spinal correction system according to claim 1 wherein:
 - said left fastener retaining portion extends from said bridge member left end adjacent one of said bridge member front side and said bridge member back side; and
 - said right fastener retaining portion extends from said bridge member right end adjacent the same said bridge member side as said left fastener retaining portion.

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4. A spinal correction system according to claim 1 wherein:
each said fastener retaining portion defines a passageway therethrough
adapted to receive a fastener.
5. A spinal correction system according to claim 1 wherein:
each said fastener retaining portion has a plurality of projections
extending from a lower surface thereof.
6. A spinal correction system according to claim 1 wherein:
said bridge member lower surface is concave in a direction from said
left end to said right end to substantially match the contour of a vertebral body.
7. A spinal correction system according to claim 1 wherein:
said bridge member lower surface is concave in a direction from said
front side to said back side to closely match the contour of a vertebral body.
8. A spinal correction system according to claim 1 wherein:
said bridge member defines a central longitudinal axis extending
along a direction from said left end to said right end;
said left fastener retaining portion lies entirely to one side of said
central longitudinal axis;
said right fastener retaining portion lies entirely to the other side of
said central longitudinal axis;
each of said fastener retaining portions defines a passageway
extending from an upper surface thereof through a lower surface thereof, said
passageway adapted to receive a fastener therein; and
each of said fastener retaining portions defines a countersunk portion
coaxial with said passageway adjacent said fastener retaining portion upper surface,
said countersunk portion adapted to receive a fastener head therein.
9. A spinal correction system according to claim 1 wherein:
a threaded post extends from said bridge member upper surface.

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10. A spinal correction system according to claim 9 wherein:
said threaded post defines a passageway coaxial therewith.
11. A spinal correction system according to claim 1 further comprising:
a pair of spaced apart legs extending from said bridge member lower
surface proximate said left and right ends.
12. A spinal correction system according to claim 11 wherein:
said legs include barbs having at least one retaining surface adapted to
inhibit withdrawal movement of said spinal correction system once said spinal
correction system has been positioned in a fixation environment.
13. A spinal correction system according to claim 11 wherein:
each said leg has a width substantially equal to a width of said bridge
member as measured from said front side to said back side.
14. A spinal correction system according to claim 11 wherein:
each said leg includes an inner surface which is splayed outwardly
away from said inner surface of the other said leg as measured from a plane passing
between said legs substantially perpendicular to said bridge member.
15. A spinal correction system according to claim 11 wherein:
said left fastener retaining portion extends from said bridge member
left end adjacent said bridge member front side;
said right fastener retaining portion extends from said bridge member
right end adjacent said bridge member back side; and
each of said fastener retaining portions are adapted to guide a fastener
in a direction substantially parallel to said legs.

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16. A spinal correction system for a spine including longitudinally aligned vertebrae, said vertebrae having confronting endplate growth centers with predetermined thicknesses, a longitudinally extending span defined between said confronting endplate growth center thicknesses, and an intervening disk positioned intermediate said end plate growth centers, said vertebrae having predetermined transverse diameters, said system comprising:
- a bridge member having an upper surface, an opposed lower surface, a front side, an opposed back side, a left end, and an opposed right end, the length of said bridge member from said left end to said right end being substantially equal to said longitudinally extending span;
- a left fastener retaining portion extending from said bridge member left end, said left fastener retaining portion having front and back sides; and
- a right fastener retaining portion extending from said bridge member right end, said right fastener retaining portion having front and back sides.
17. A spinal correction system according to claim 16 wherein:
each of said fastener retaining portions are proportioned so that when first and second ones of said spinal correction systems are positioned with one of said ends of said first spinal correction system adjacent one of said ends of said second spinal correction system thereby defining a pair of adjacent ends, each of said fastener retaining portions extending from said adjoining ends is positioned with one of said sides facing one of said sides of the other said fastener retaining portion extending from the other said adjoining end.
18. A spinal correction system according to claim 16 wherein:
said left fastener retaining portion extends from said bridge member left end adjacent one of said bridge member front side and said bridge member back side; and
said right fastener retaining portion extends from said bridge member right end adjacent the opposite said bridge member side as said left fastener retaining portion.

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19. A spinal correction system according to claim 16 wherein:
said left fastener retaining portion extends from said bridge member
left end adjacent one of said bridge member front side or said bridge member back
side; and
5 said right fastener retaining portion extends from said bridge member
right end adjacent the same said bridge member side as said left fastener retaining
portion.
20. A spinal correction system according to claim 16 further comprising:
a pair of spaced apart legs extending from said bridge member lower
surface proximate said left and right ends.
21. A spinal correction system according to claim 19 wherein:
said legs are proportioned to extend less than one-half said diameter
of said vertebrae.
22. A spinal correction system on a growing spine having abnormal
curvature defining a convex side, the spine including a plurality of lengthwise
adjoining vertebrae, the vertebrae including endplate growth centers with an
intermediate portion therebetween, the vertebrae further having transverse diameters,
5 the system comprising:
a first bone engaging means penetrating the convex side of an
intermediate portion of a first vertebra to a depth of about one-half the diameter of
the first vertebra;
a second bone engaging means penetrating the convex side of an
10 intermediate portion of a second vertebra to a depth of less than one-half the diameter
of the second vertebra; and
a bridge member rigidly connecting said first means and said second
means;
whereby said system corrects the abnormal curvature of the growing
15 spine by inhibiting the growth of the endplate growth centers between said first and
second bone engaging means on the convex side of the spine.

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23. A spinal correction system according to claim 22 wherein:
said first and second bone engaging means each comprise a substantially wedge-shaped leg extending substantially perpendicularly proximate from respective first and second ends of said bridge member.
24. A spinal correction system according to claim 22 wherein:
said first and second bone engaging means each comprise a fastener retaining portion extending substantially lengthwise from respective first and second ends of said bridge member.
25. A spinal correction system according to claim 24 wherein:
said first and second fastener retaining portions are proportioned so that when two said systems are arranged end-to-end on a spine, adjoining fastener retaining portions lie adjacent each other.
26. A spinal correction system comprising:
a bridge member having an upper surface, an opposed lower surface, a front side, an opposed back side, a left end, and an opposed right end, said upper surface substantially planar in a direction from said left end to said right end, said
5 upper surface convex in a direction from said front side to said back side, said lower surface concave in a direction from said left end to said right end;
a pair of spaced apart legs extending from said lower surface at said left and right ends, each of said legs being substantially wedge-shaped, each of said legs having a width substantially equal to a width of said bridge member from said
10 front side to said back side, each said leg having an outer surface and an opposed inner surface, said inner surfaces facing each other, each said leg having a front surface and an opposed back surface, each said leg having a plurality of barbs projecting from each of said outer, inner, front, and back surfaces, said inner surfaces of said legs angled away from each other from vertical;
15 a left fastener retaining portion extending from said bridge member left end;

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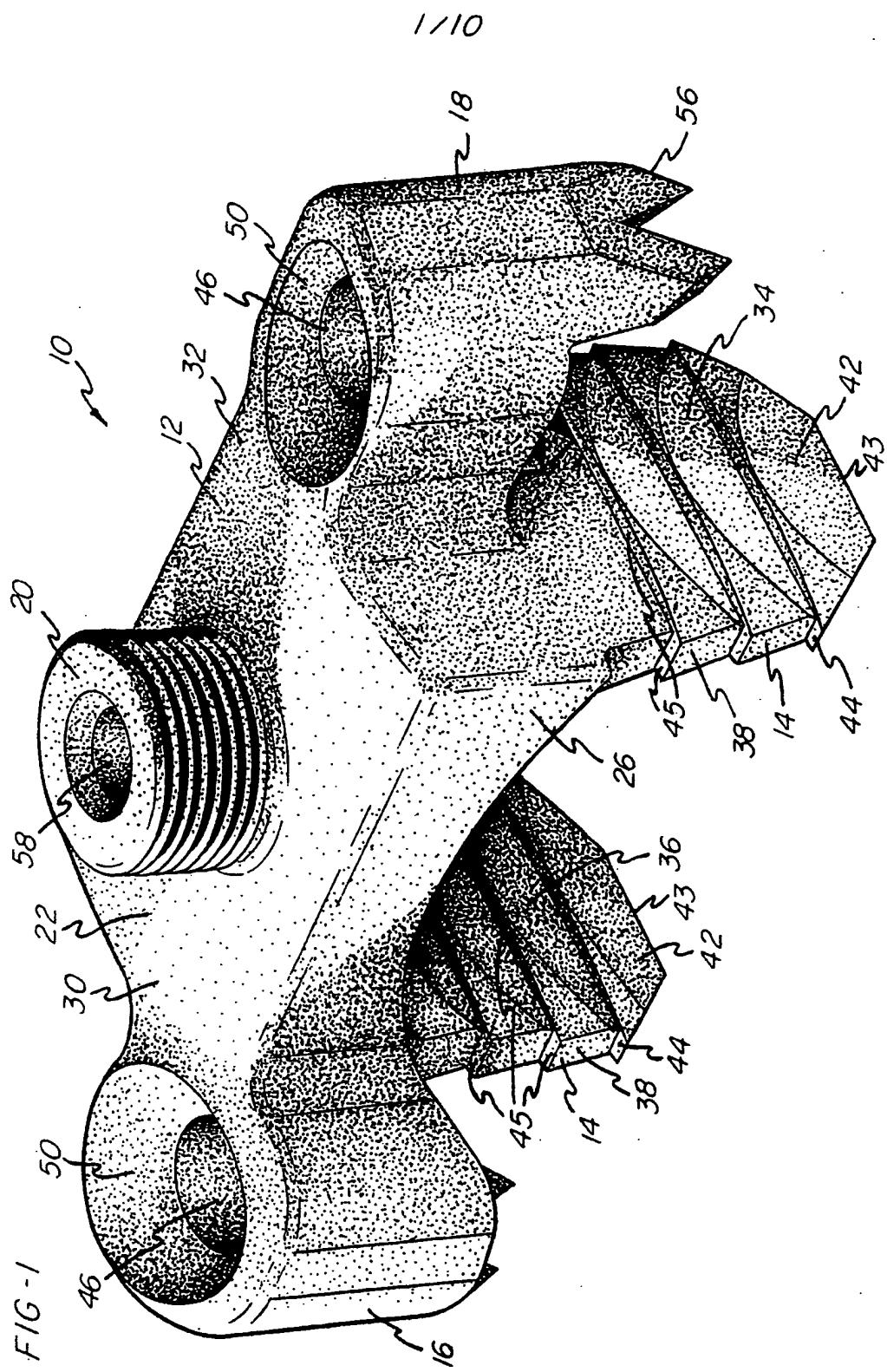
a right fastener retaining portion extending from said bridge member right end;

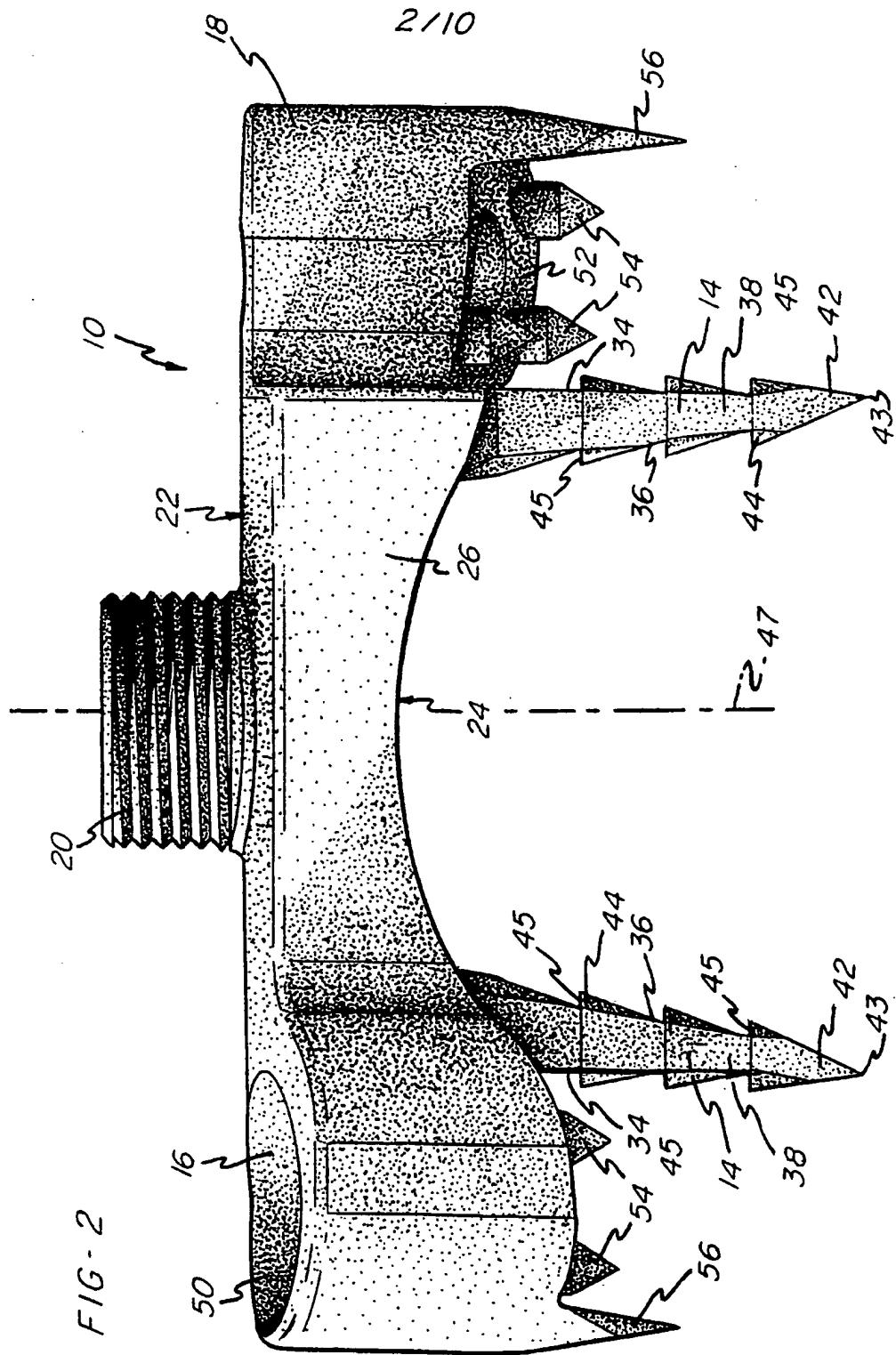
each of said fastener retaining portions defining a passageway

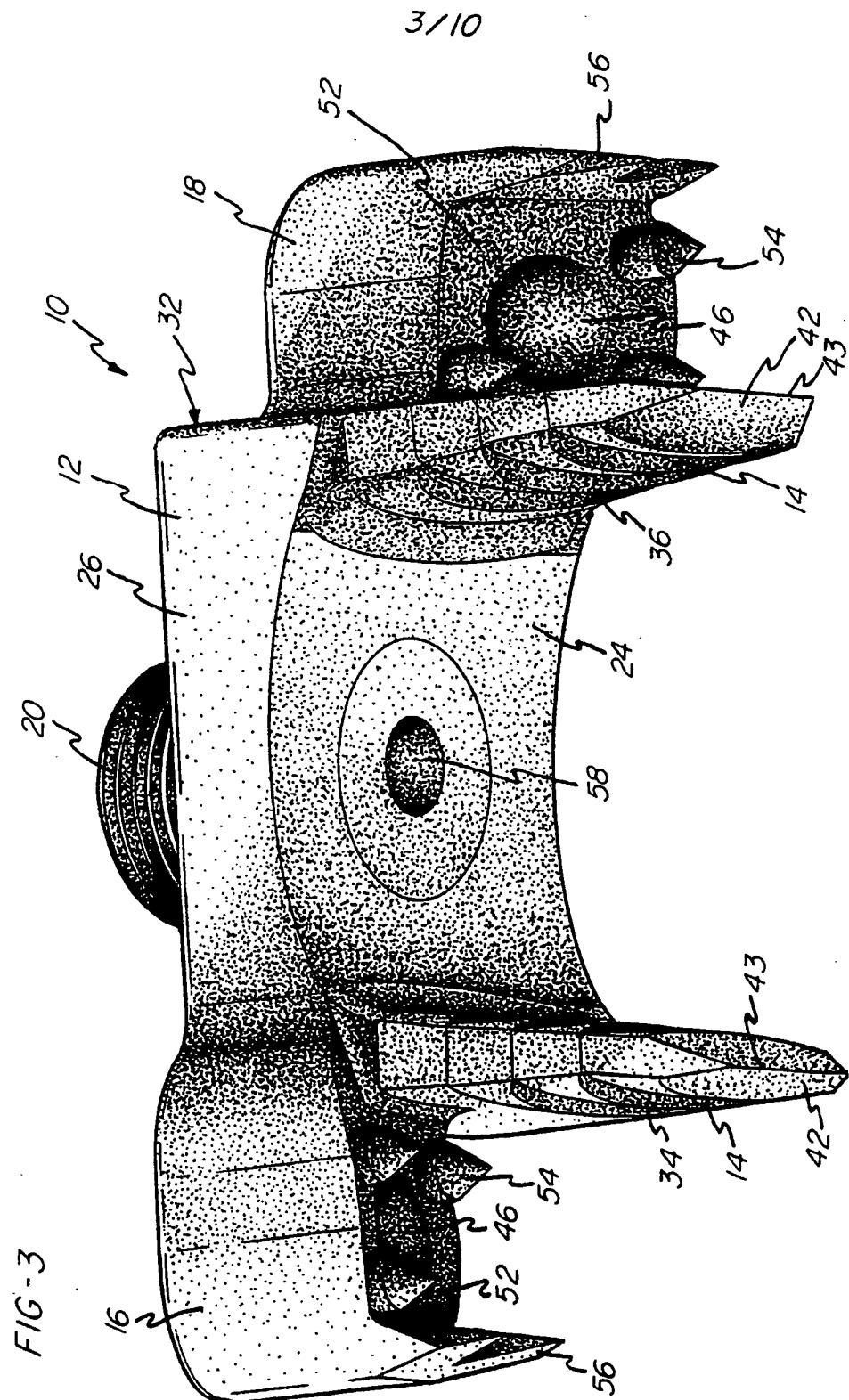
20 therethrough adapted to receive a fastener therein, each of said fastener retaining portions adapted to guide a fastener in a direction substantially parallel to said legs, each of said fastener retaining portions having a plurality of projections extending from their lower surfaces; and

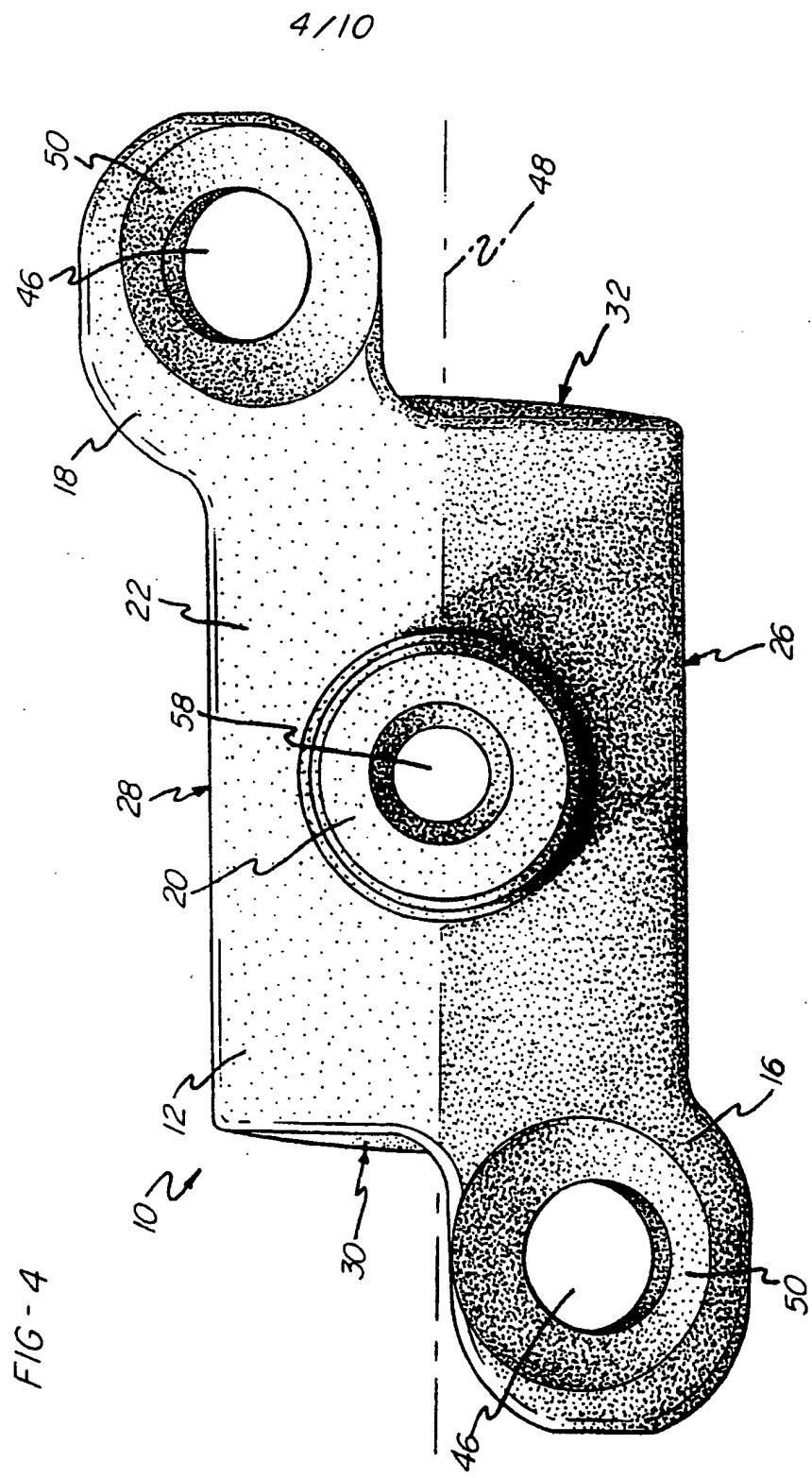
a threaded post extending from said upper surface of said bridge

25 member, said bridge member and said threaded post cooperating to define a passageway therethrough, said passageway coaxial with said threaded post, said threaded post facilitating the attachment of a cannulated removable impactor device.



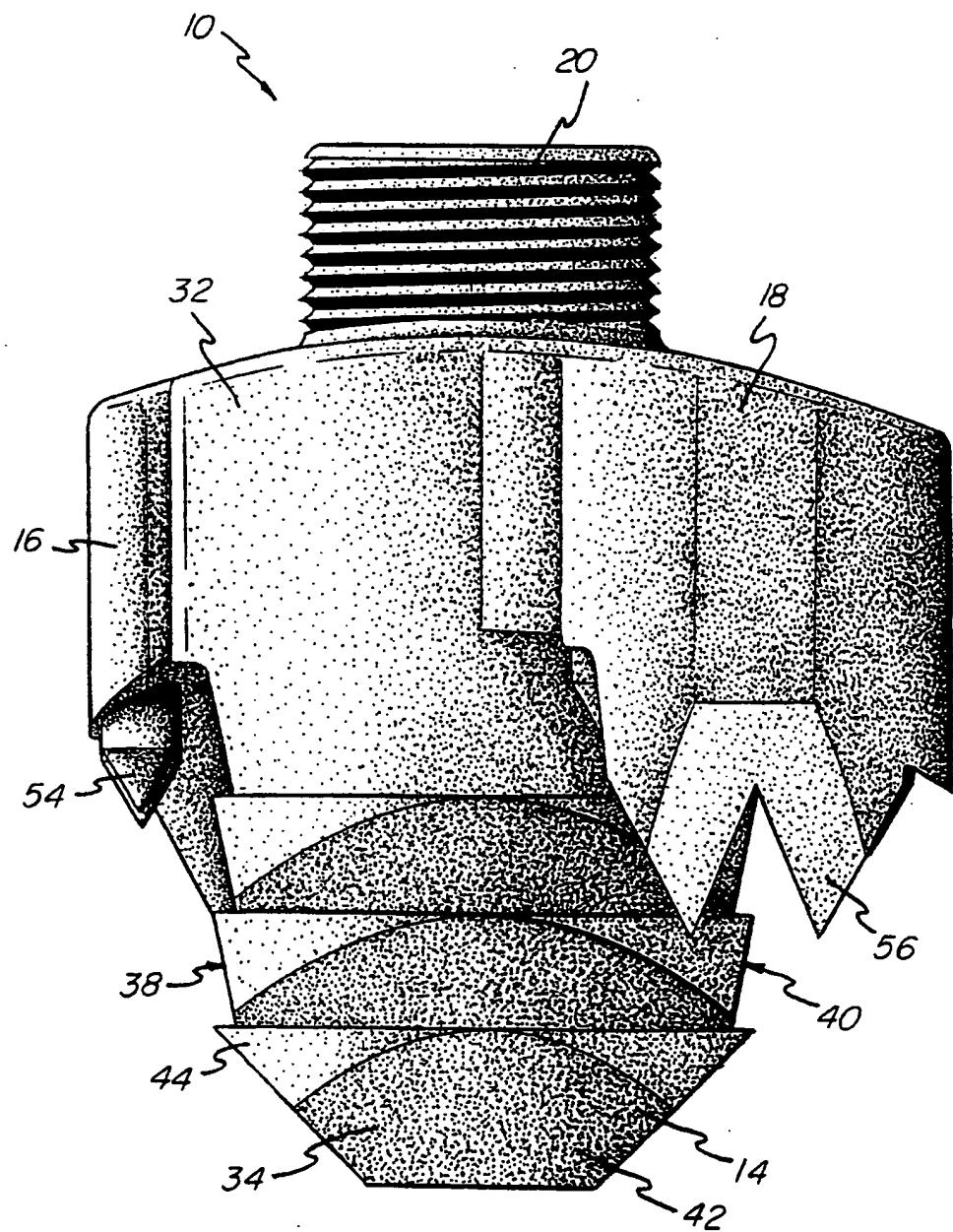


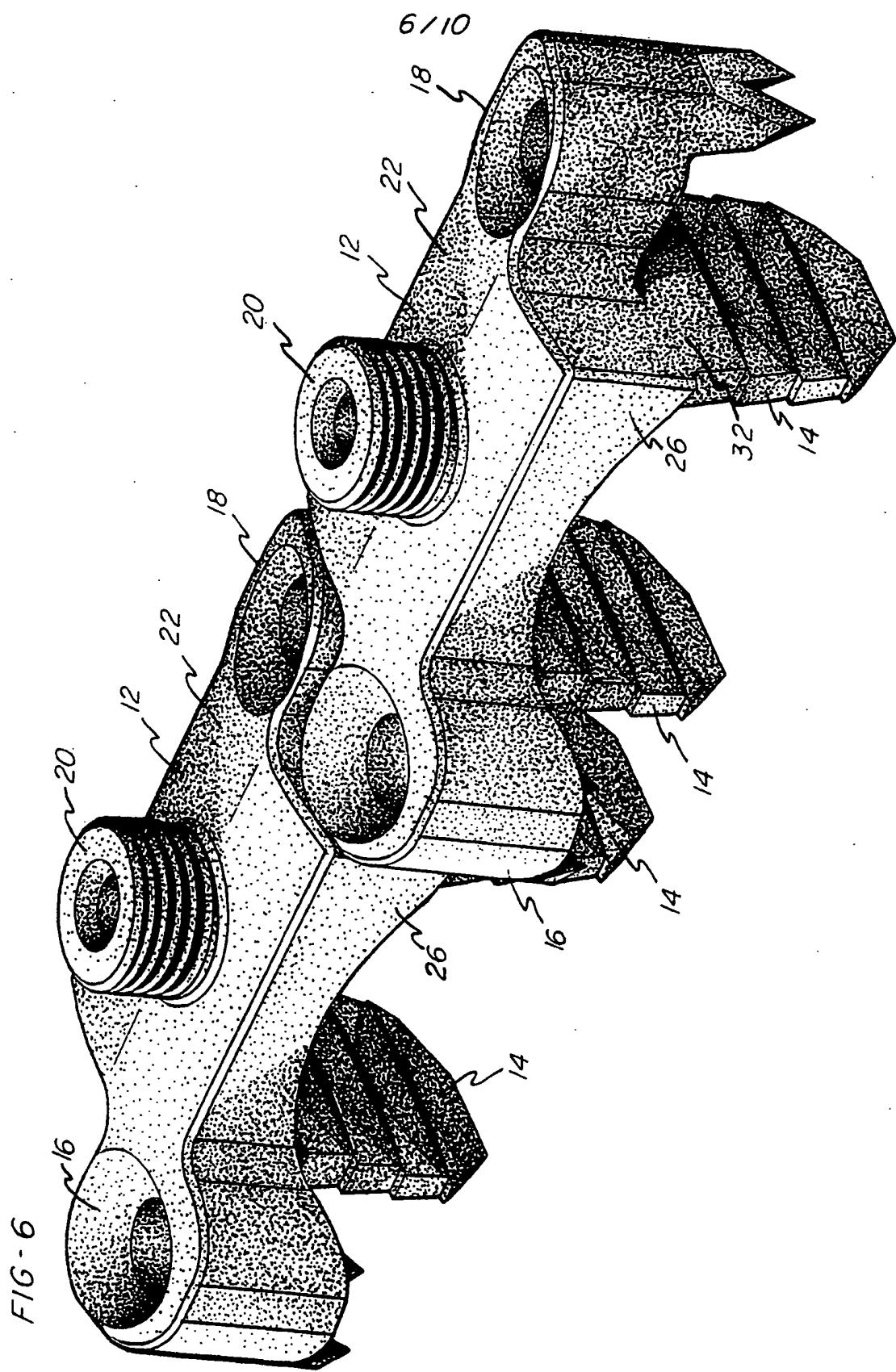




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FIG - 5





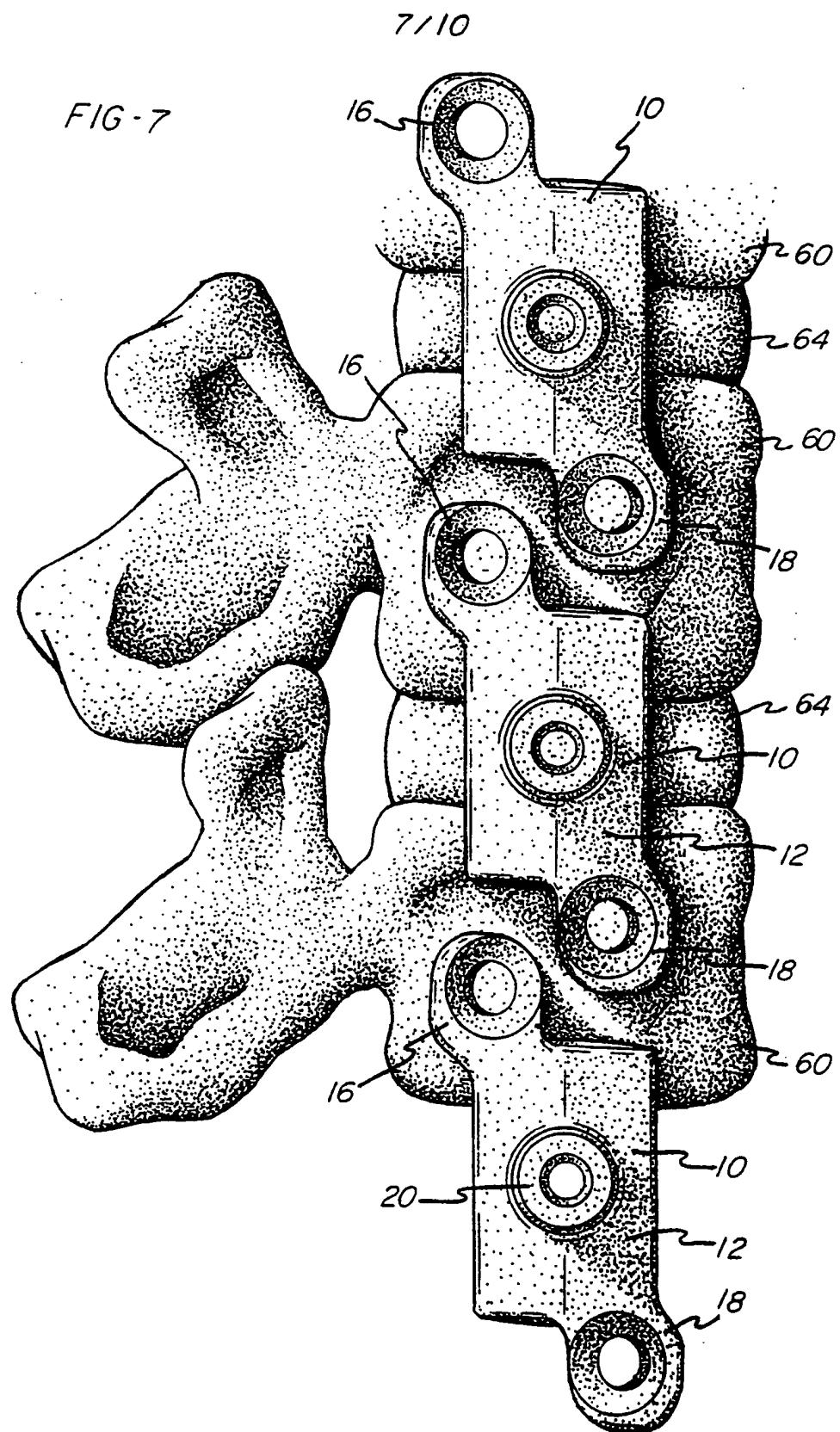
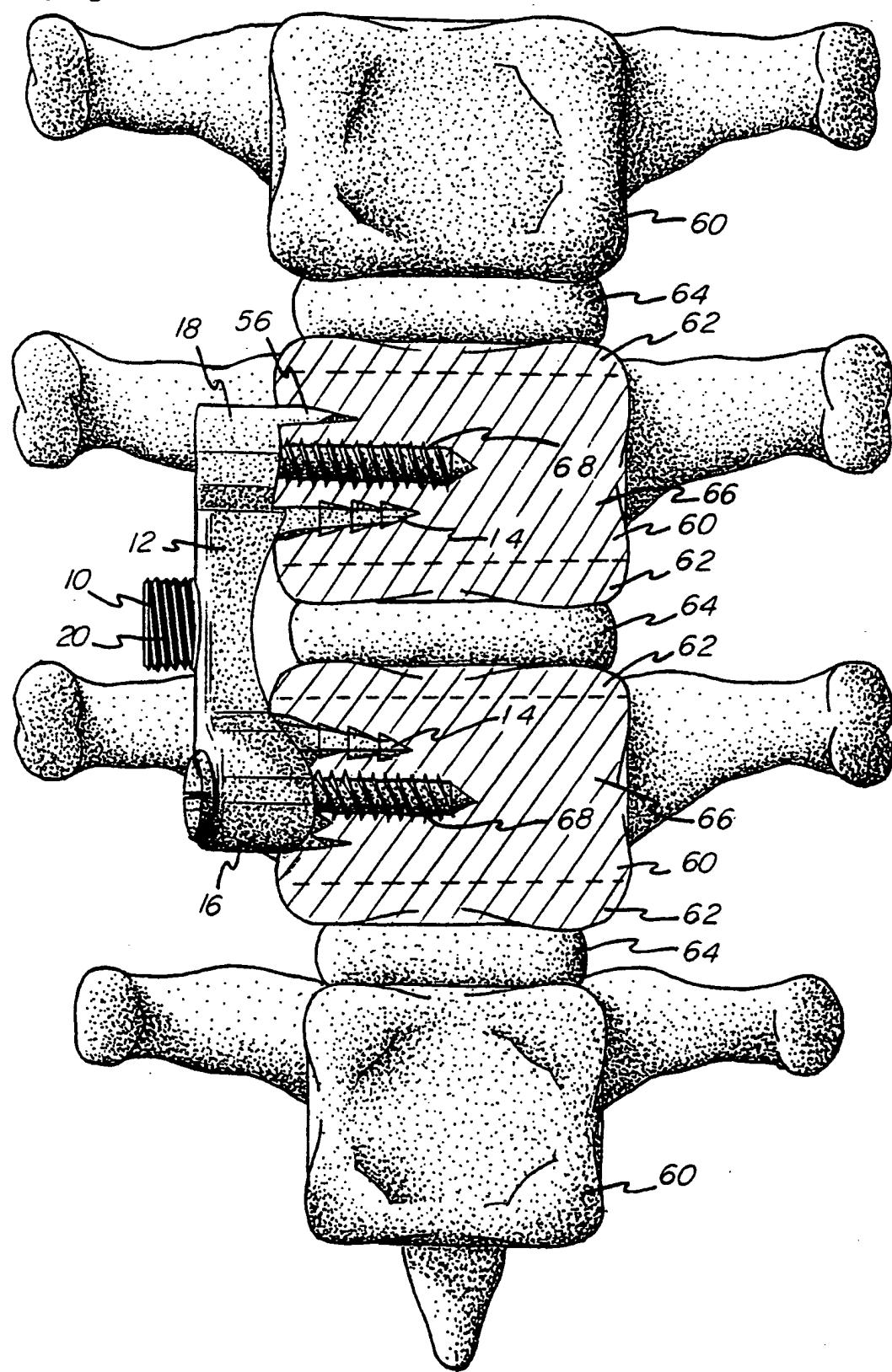


FIG. 8

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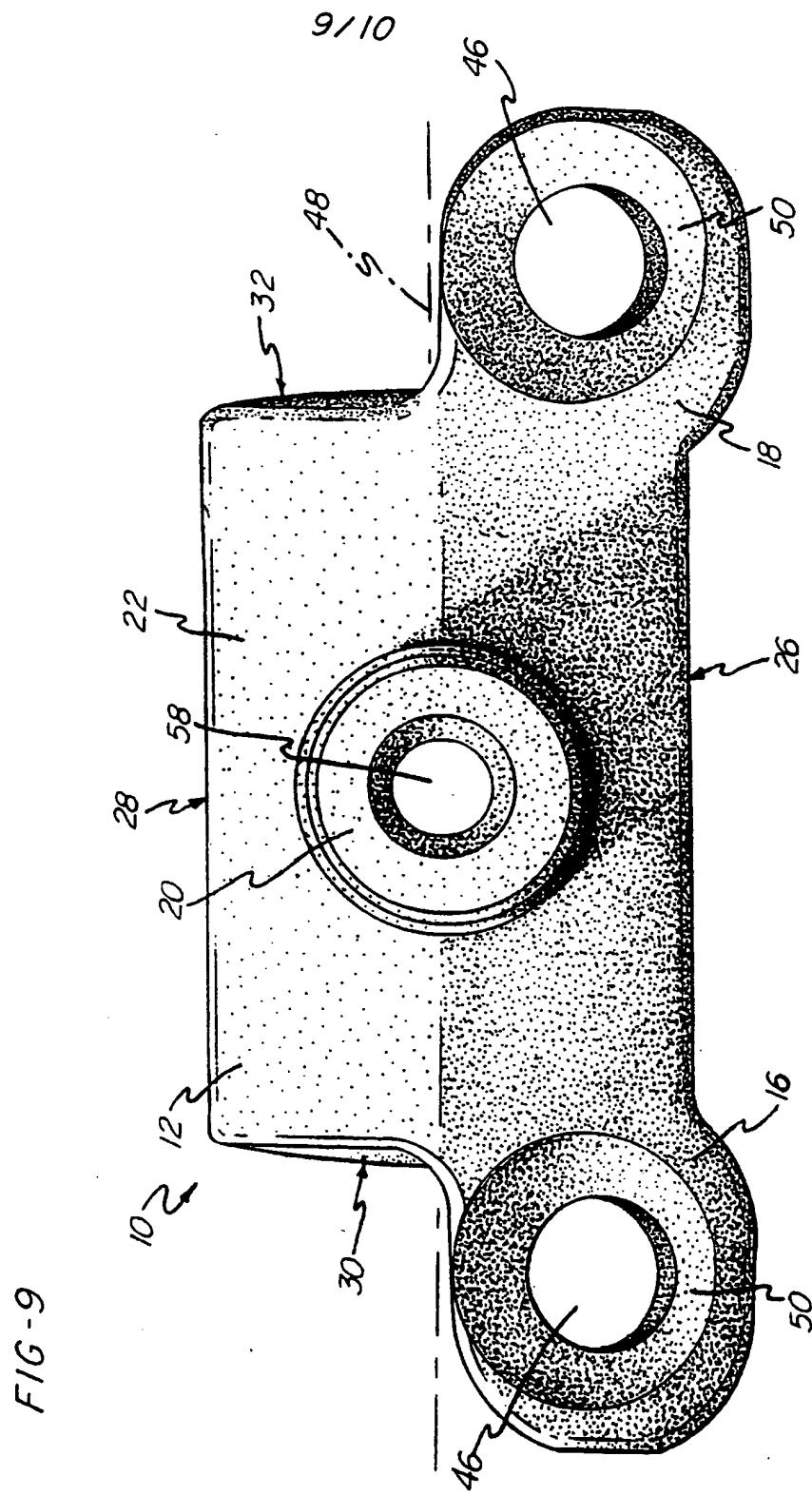
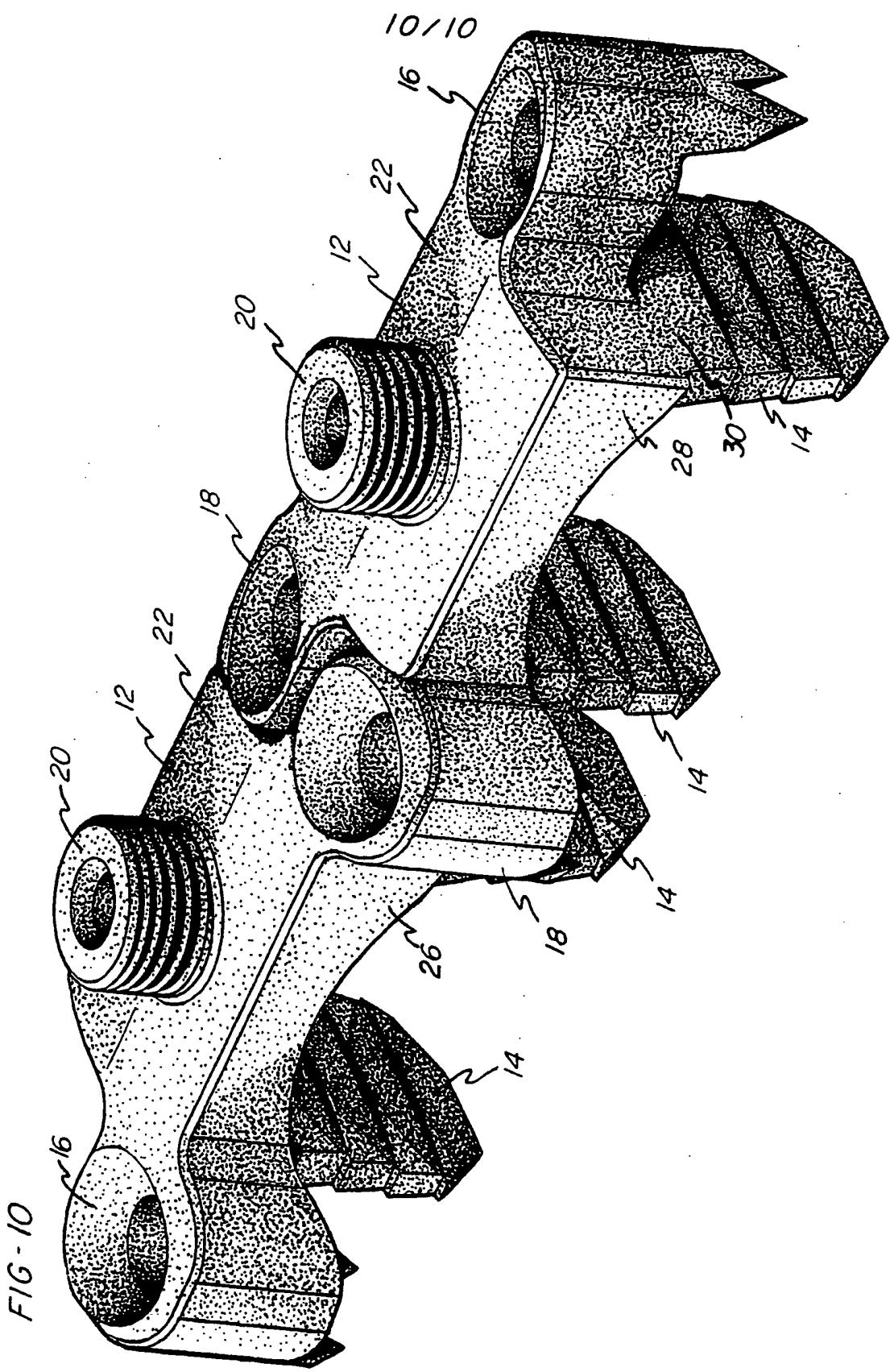


FIG-9



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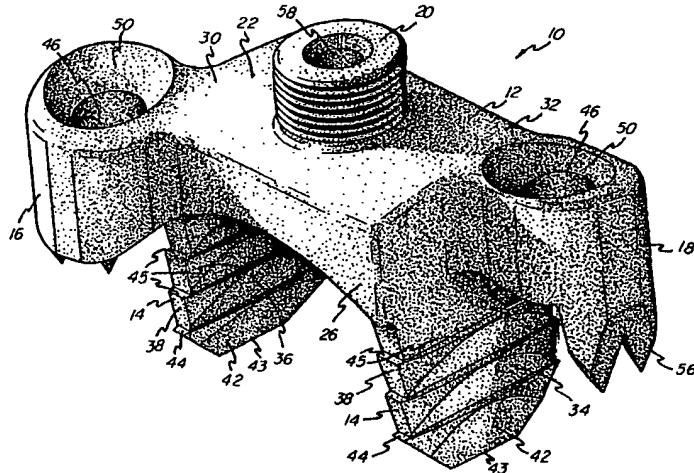
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- (71) Applicants and
(72) Inventors: WALL, M., D., Eric, J. [US/US]; 3280 Tiffany Ridge Lane, Cincinnati, OH 45241 (US). BYLSKI-AUSTROW, Ph., D., Donita, L. [US/US]; 4932 Twinbrook Court, Cincinnati, OH 45242 (US).

For two-letter codes and other abbreviations, refer to the "Guidance Notes on Codes and Abbreviations" appearing at the beginning of each regular issue of the PCT Gazette.

(54) Title: SPINAL CORRECTION SYSTEM



WO 01/003570 A3

(57) Abstract: A spinal correction system for the correction or arrest of scoliosis or spinal deformity in immature spines includes a bridge member (12), a pair of spaced apart barbed legs (14) extending substantially perpendicularly therefrom, and a fastener retaining portion (16, 18) extending substantially longitudinally from each end of the bridge member (12). The fastener retaining portions (16, 18) are adapted to lie in adjoining relationship when two or more spinal correction systems are arranged in end-to-end abutting relationship. The spinal correction system is intended to correct or arrest scoliosis in a growing spine by spanning the end plate growth centers of adjacent vertebrae, on the convex side of the malformed spine, and to retard growth of that side of the spine while permitting unrestrained growth of the concave side of the spine.

INTERNATIONAL SEARCH REPORT

International application No.
PCT/US00/18491**A. CLASSIFICATION OF SUBJECT MATTER**

IPC(7) :A61B 17/56

US CL :606/61

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

U.S. : 606/61, 62, 69-72, 75; 623/17.11, 17.16

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 5,405,391 A (HEDNERSON et al.) 11 April 1995, figures.	1-4, 6, 16-19, 21, 22, 24, 25
Y		7, 8
Y	US 5,261,910 A (WARDEN et al.) 16 November 1993, figures.	8
A	US 5,108,395 A (LAURAIN) 28 April 1992, entire document.	1-26
A	US 4,570,623 A (ELLISON et al.) 18 February 1986, entire document.	1-26
A	US 4,599,086 A (DOTY) 08 July 1986, entire document.	1-26

Further documents are listed in the continuation of Box C. See patent family annex.

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"A"		document defining the general state of the art which is not considered to be of particular relevance
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"O"		document referring to an oral disclosure, use, exhibition or other means
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	"&"	document member of the same patent family

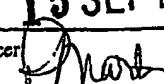
Date of the actual completion of the international search

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Name and mailing address of the ISA/US
Commissioner of Patents and Trademarks
Box PCT
Washington, D.C. 20231
Facsimile No. (703) 305-3230

Authorized officer 
EDUARDO C. ROBERT
Telephone No. (703) 305-7333

INTERNATIONAL SEARCH REPORTInternational application No.
PCT/US00/18491**C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT**

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	US 4,651,724 A (BERENTBEY et al.) 24 March 1987, entire document.	1-26

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